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Transaction Network, Telephones, and Terminals:

Transaction Network Service

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Transaction Network Service is provided by a message-switched communication system especially designed for short formatted data messages. The Transaction Network system carries messages between Customer Service Centers (customer-owned data processing centers) and polled terminals or dial-in Transaction telephones, as well as between Customer Service Centers. It does this quickly and economically, with high reliability and maintainability of service. This paper discusses first the need for Transaction Network Service and the system design goals set for it. Then the elements of the system are discussed, including how they work together in providing service.

I. A NEED FOR TRANSACTION NETWORK

Short data messages of the inquiry/response type have in the past been carried by two types of available telecommunications service offerings. One is the Public Switched Telecommunications network using either simple voice conversations, data and automatic voice response units, or full two-way data exchange. The other is the use of multipoint private line networks between terminals and computers in full two-way data exchange. Issues of cost, response time, reliability, engineering, and administration all arise and become more serious as greater volumes of transactions occur and as more locations are served.

Inward Wide Area Telecommunications Service—INWATS—is the common way of using the dial network. It puts no toll charges on the calling party, and is cost-effective for low volume/high value messages. Translation of the 800-type number cannot economically be provided in every service central office. An INWATS call must therefore be routed first to a toll office capable of the translation, and routed from there to

the destination. Call setup times of some 12 seconds are common. Thus it is slow, and even though toll charges are relatively low, the net result is that it is most effective for high value transactions.

The multipoint private line network is appropriate for high volumes and fast response times. These two factors and the number of stations to be served determine the specific configurations. Restrictions occur because of technical considerations. As more stations are bridged together, the potential for electrical noise and echoes increases. The solution for echoes is to use separate channels for transmit and receive, causing increased cost. Noise limitations may govern the number of stations per multipoint circuit because the noise received at the host computer is effectively the sum of the noise in all the elements of the bridged multipoint circuit. When noise becomes excessive, the performance of the circuit degrades. Diagnosis and repair may be disruptive and tedious since the entire circuit must be removed from service and its components tested until the offending source is isolated and then repaired.

A further complication in multipoint circuits is in disciplining the flow of information. For example, only one terminal should send a message to the host computer at any one time. Not only is this discipline, called a protocol for information interchange, a nontrivial task, but different types of terminals commonly use different protocols. Thus, independent circuits and access arrangements to the host computer and independent "protocol software" in the computer are all required when differing types of terminals are needed and deployed.

The Transaction Network system addresses these issues positively. It includes a superior alternative to the multipoint bridged channel. It performs protocol management to permit a host computer to communicate with several types of terminals through one protocol, one software package, and one type of access arrangement. It uses the dial network for access when appropriate: by offering an Automatic Voice Answerback service, it makes the use of the dial network effective for residences as well as places of business.

As a brief characterization, Transaction Network Service is effective because it is a total system designed to meet the needs of the inquiry/response market. The following section discusses this in more detail.

II. SYSTEM GOALS

Figure 1 is a conceptual view of the design goals for the Transaction Network system. "Common user" is a goal from several perspectives. One is that a terminal or telephone may require connectivity to several Customer Service Centers to conduct the desired variety of transactions. Some terminals may not need such varied connectivity, but can benefit from the economies gained by sharing use of the network with others. TNS meets both needs, the former by having a switching capability and

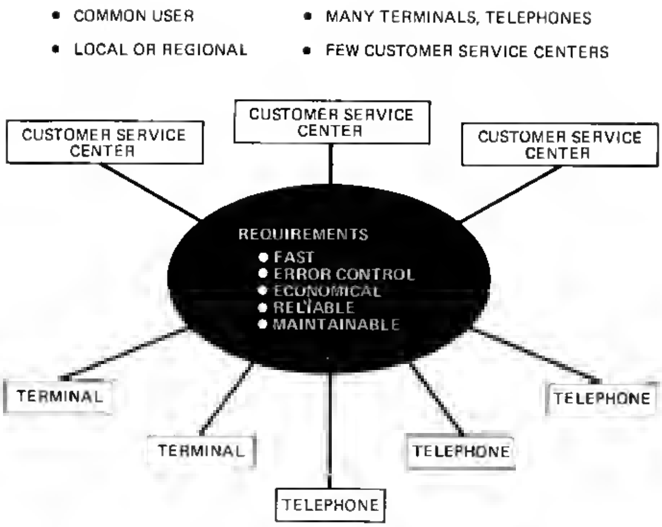

Fig. 1—Transaction Network design goals.

the latter by incorporating restricted routing options between terminals and Customer Service Centers and between affiliations of Customer Service Centers. The use of a single integrated system permits several users to share in the necessary costs of administration, engineering, and maintenance to their mutual benefit in cost and quality of service.

"Local or regional," in Fig. 1, relates to cost optimization and is listed because analysis shows a major component of cost in typical customer-designed networks to be in the local distribution network. This is one area where new economies are needed, and where they are provided.

Many terminals and telephones of several different types and few Customer Service Centers constitute the typical nature of the inquiry/response short data message market. In particular, Customer Service Centers served by Transaction Network Service will show major economies and simplification in hardware and software because of the protocol management capability of TNS. One type of connection and software in the customer's computer will reach the several types of terminals, but any terminal meeting the appropriate specifications will be supported. Transaction Network Service does not include the front-end hardware and software required at the customer's computer to interface with the network. The customer must provide these, as well as the computer itself.

Requirements and specifications for the interfaces to Customer Service Centers and to polled and dial-in terminals are available in the form of Bell System Technical Reference publications.[1–4]

The most important attributes of the Transaction Network are in the center of Fig. 1. Messages are carried with minimal delay. There is no store-and-forward or multiple address (broadcast) aspect to the

Transaction Network: messages that cannot be delivered are returned to the sender, with the type of irregularity encountered indicated in the returned message. Positive error control, on each link in the network, is also of major importance. The synthesis of these two aspects is that the customers can use the network confidently; the messages will be carried exactly as entered into the network—if they cannot, the user will know it promptly and unequivocally. In particular, the design of the Transaction Network makes it possible almost to eliminate uncertain transactions, at least insofar as network performance may contribute.

Reliability and maintainability must be and are high, promoting service availability at tbe levels needed by users. How this is achieved is best discussed after describing bow the Transaction Network operates.

The following sections of this paper present an overview of the services provided and the functional operation of the system, serving as an introduction to the accompanying in-depth articles. As with most systems of the complexity of Transaction Network, numerous acronyms have developed. The appendix contains a listing of those used in this and the accompanying papers.

III. POLLED TERMINAL SERVICE

Figure 2 shows at the left polled terminals and at the right Customer Service Centers. Between them lie the polled access network, the message switch, and the synchronous links to the data processing centers.

Consider first the message switch. Typically, there is one of these in a metropolitan area, although, in large areas and as traffic grows, more than one may be needed. This message switching unit not only controls and routes the flow of messages, but also tests itself and the communication network it controls. It also does billing, traffic, and administrative tasks. Its use is shared by all subscribers.

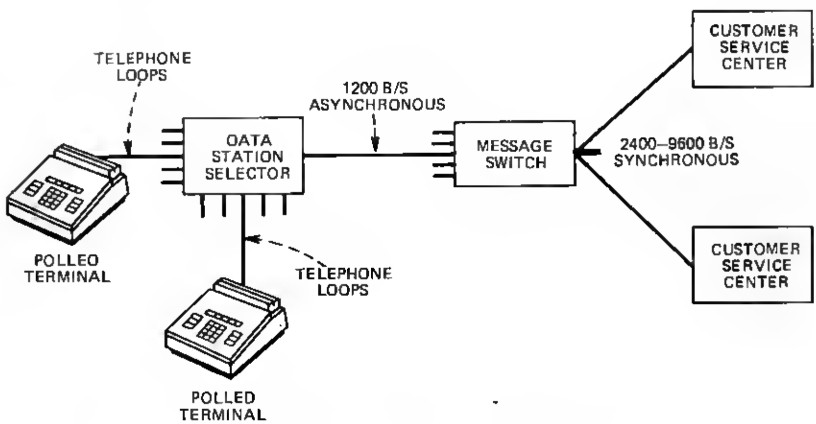

Fig. 2—Transaction Network (polled access).

The Data Station Selector is a newly developed, solid-state line concentration device leading to economies in local distribution costs. It is installed in the wire centers nearest the terminals, and can also be installed on customer premises. Its use is shared by up to 61 terminals. Each terminal is served by a two-wire loop which terminates in a Channel Service Unit. The loops are ordinary voice-grade quality with no special engineering required in the vast majority of the cases. The Channel Service Unit, which is an integral part of the network, is for maintenance purposes and for adjusting loop loss to meet the fixed level transmission plan. The chosen data speed, 1200 b/s, facilitates meeting the objectives of "no special engineering" of loops, the undetected error rate goal, and the speed of service goal.

Once the terminal is armed to transmit a message, carriage of the message begins with polling the terminal by the message switch. The Data Station Selector is commanded by the message switch to connect a specified terminal to the backbone trunk between the Data Station Selector and the message switch. Then the message switch sends an alerting signal to the terminal. This alerting signal is the same for all terminals: it is not a unique identification number for the specific terminal.

If the terminal has no message to send, it remains silent and, after a brief interval, the message switch moves on to poll other terminals.

The grade-of-service objective is 1.25 seconds on the average for access delay. That is, the average delay between arming a terminal to send a message and the start of its transmission towards the message switch is 1.25 seconds. The number of terminals supported by each Data Station Selector is engineered to meet this objective, the criteria including the amount of traffic generated by the terminals.

If a message is ready, it will be sent, and it must be of the form shown in Fig. 3. The major parts of this message are the heading, the text, and the Longitudinal Redundancy Check character. The BAL (Blind Alert) character leads all messages: it distinguishes a message from a command to the Data Station Selector. The heading is required because the Transaction Network is a switched service, requiring the routing infor-

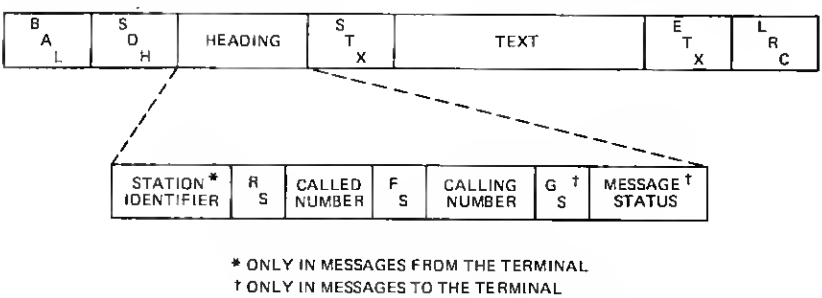

Fig. 3—Polled terminal message format.

mation contained in the heading. In the heading the Station Identifier field tells what kind of terminal is transmitting, to distinguish the user features of one terminal from another—information of particular interest to the data processing center in composing a response message to use these features most appropriately.

The called number in an inquiry message is that of the Customer Service Center. A new seven-digit number plan, totally independent of the usual telephone number directory plan, has been created. All seven digits in the calling and called number plan are not always needed.

In particular, polled terminal users can option "restricted access," and then the polled terminal can call or be called only by designated Customer Service Centers. In such a case, one number, and even no number (that is, implied addressing), is enough for the called number. Obviously, both the polled terminal and the Customer Service Center subscribers must agree to such an arrangement.

The calling number applies to the terminal and also is assigned by the telephone company. It is checked by the message switch to ensure that the Data Station Selector accessed the proper terminal; having it in the message is also a convenience to the Customer Service Center, since it is the directory number of the terminal. It could also be used as an identification of the calling party.

The message status field is not sent by a polled terminal. In case of irregularities, it occurs in messages to the terminal and identifies the irregularity.

Text is strictly under user control and is not rearranged or altered by the Transaction Network. All characters throughout are ASCII; text must be 128 characters or less, and not include control characters.

When the message arrives at the message switch, the following checks are among those made: the calling number is correct; parity in every character is correct; the Longitudinal Redundancy Check character, an overall parity test on the whole message, is also correct.

If all tests are passed, the message switch sends ACK (Acknowledgment) and the terminal then sends EOT (End of Transmission). Then the message forwarding begins. If any test fails, NAK (Negative Acknowledgment) is sent, and polling is resumed. On the next polling cycle, transmission is attempted again.

Figure 4 illustrates some of the possible modes of operation of this protocol. On the top two lines is seen a normal inquiry message transfer. Then the effects of three types of transmission errors are illustrated. The last two illustrate that no EOT (End of Transmission) from the terminal within an allotted time is cause for the message switch to send ACK again but that a garbled EOT is cause for an ENQ ("what was sent?") from the message switch and a subsequent retransmission of EOT by the terminal. Only the message switch can send ENQ. This protocol should yield an undetected error rate of 1 in 10^7 messages, or better.

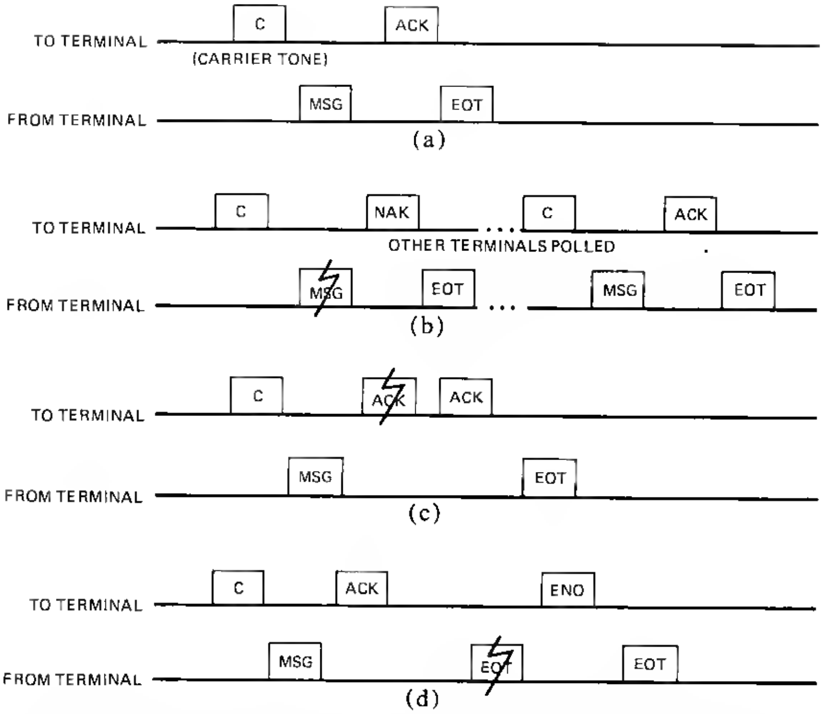

Fig. 4—Polled terminal protocol, inquiries. (a) Inquiry message, normal dialog. (b) Inquiry message, garbled. (c) Inquiry message, control garbled. (d) Inquiry message, termination garbled.

After additional checks, the message enters the buffer to the designated Customer Service Center. Among these tests is the class-of-service test. For example, if the Customer Service Center has elected not to accept messages from unrestricted polled terminals or from dial-in telephones, then the check will result in such messages being turned back, with appropriate message status codes.

When the Customer Service Center has processed the inquiry and sent a response message back to the message switch, the response enters the buffer for the Data Station Selector serving the proper polled terminal. Polling is interrupted and the message sent to the terminal. Errors are checked, and when ACK and EOT have occurred, the terminal can present the response to the user. The tests include correct called number, i.e., the message has reached the correct terminal. They may also include a test on the Customer Service Center to which the inquiry was sent, but this is strictly optional. The Transaction Network does not pair inquiries and responses. A terminal may send several inquiries one after the other and may receive several responses one after the other. The only restriction is that only one message may be sent per poll cycle.

IV. CUSTOMER SERVICE CENTER SERVICE

The synchronous link connecting the message switch to the Customer Service Center operates under an ANSI standard Binary Synchronous Control protocol. Although four-wire synchronous channels are used, the protocol is basically half-duplex. The message switch and the Customer Service Center take turns originating message flows, the other end checking for errors and acknowledging or negative acknowledging as appropriate, with retransmission the error recovery technique.

Figure 5 shows some details of the message composition for all messages to and from the Customer Service Center. On the top line, the SYN character is standard for achieving character synchronization. The prefix may be specified by the Customer Service Center to make its work easier—in all, there are some 24 options possible, all made available to make the Transaction Network easier to accommodate with existing Customer Service Center software. Text is the original, unaltered text. The suffix is again a Center option, and the LRC is the Longitudinal Redundancy Check character for the message. The goal of 1 in 10^7, or better, undetected error rate for messages applies to this link also.

The second line shows the components of the heading. The Heading Item Indicator tells what fields are in the heading. The Station Identification, called and calling numbers are as in the terminal's message but now the calling and called numbers are the full seven digits, and the sequence number counts the messages to help control flow over the link.

The third line on the figure is perhaps the most important. The Transaction Network can operate with one message per block, but it also can transmit and receive multiple messages in a block, as well as transmit several blocks before relinquishing the line to the Customer Service

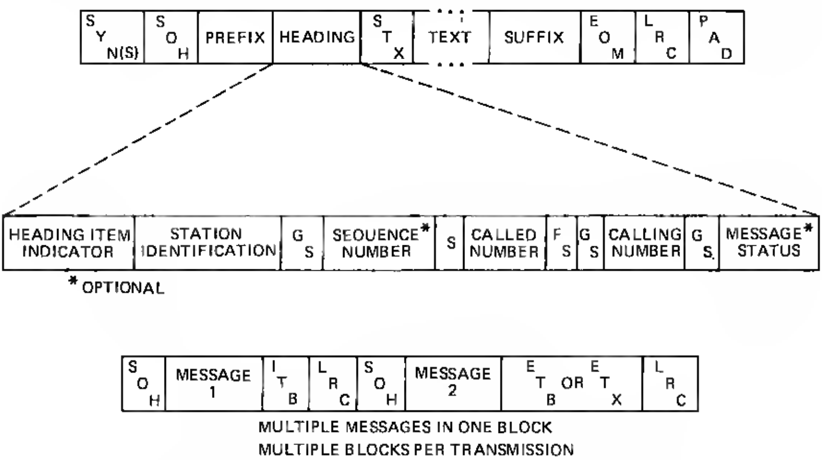

Fig. 5—Customer Service Center message formats.

Center. This should be the method of operation when efficiency is important. The Customer Service Center should be able to operate in the same way. The benefit is a faster transaction time (inquiry to response) and a more efficient, and thus lower cost, synchronous channel and associated hardware system.

Not shown is the list of Service Messages that can pass between the Customer Service Center and the message switch. They are appropriate to the application but include the ability to invoke a particularly valuable feature—alternate delivery. If, for example, the center needs to go out of service for maintenance, it can instruct the message switch to deliver messages to another center, until the command is cancelled. Obviously, prior arrangements must be made with both the telephone company and the other center. And, naturally, this feature will also be invoked if there is an unscheduled loss of eitber the synchronous channels or Customer Service Center—the feature provides both an automatic and a controllable backup.

After composing the response, the Customer Service Center sends it to the message switch using the same message format as in Fig. 5. The checks on errors are made, as are class-of-service tests. In particular, centers can form "affiliations" and message flows between centers will then be screened accordingly and turned back if inappropriate. Each center may belong to more than one affiliation.

V. DIAL-IN TELEPHONE SERVICE

Figure 6 shows dial-in service arrangements also, and is intended to suggest that three types of dial-in protocols are offered. One is for an ordinary *TOUCH-TONE®* service telephone with 12 keys, i.e., the $*$ and # keys must be present. It transmits *TOUCH-TONE* signals, and receives responses through the Audio Response Unit (called Automatic Voice Answerback service). The protocol that supports this telephone is called the Voice Response protocol. A second is represented by the Bell System Transaction I telephone: it transmits all 16 of the possible *TOUCH-TONE* signals,* and the messages include two characters for error detection. Responses to it can be of three forms: an audio message; a keyed answer tone of 1.5 seconds to light a light, for example; or a keyed answer tone of 3.0 seconds to light a different light, after which an audio message is given. This protocol is called the Voice/Keyed Answer Tone (KAT) protocol.

The third telephone is exemplified by the Transaction II telephone and uses a different telephone number to access the ports on the message switch. This terminal uses all 16 *TOUCH-TONE* signals to transmit, but receives data responses, frequency-shift-keyed at 150 b/s, and can retransmit to overcome detected errors. Its protocol is called the Data

* The unusual four *TOUCH-TONE* signals are here called *a*, *b*, *c*, and *d*.

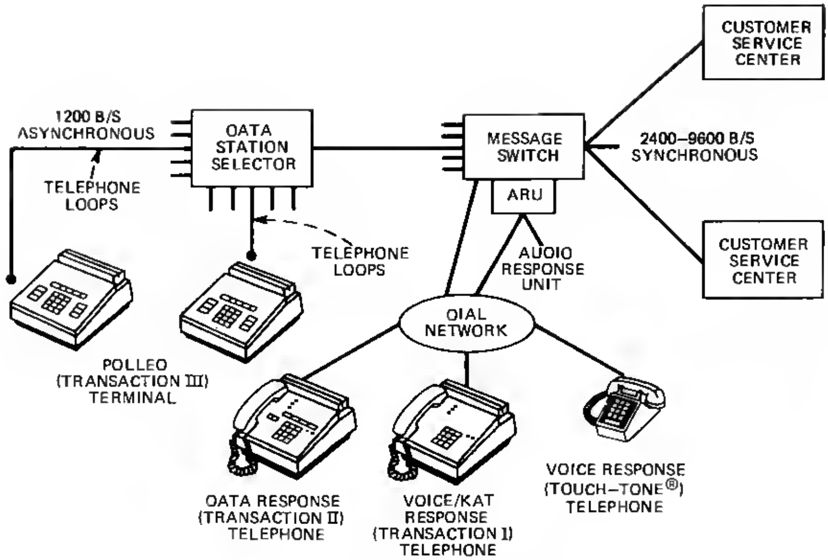

Fig. 6—Transaction Network.

Response protocol.

To illustrate dial-in service, consider now the second arrangement, using the Voice/KAT protocol. The first step in its use is to dial, as with an ordinary telephone, a number assigned to the ARU port hunting group for the message switch. When the connection is made, an answer tone will be sent from the port to the telephone for 1.5 seconds. After this, the telephone may transmit a message such as is indicated in Fig. 7.

First comes the heading. In it, the *b* signal is used to differentiate this telephone from a *TOUCH-TONE* telephone, and *b*20 together constitute both the Start of Heading (SOH) and the station identifier field (as seen earlier for the polled terminal). Then *b*8 is a field separator, and 5550076 is the Transaction Network identification for a specific Customer Service Center.

The calling number does not appear in this heading because Transaction Network service does not include Automatic Number Identification. That is, the message switch cannot automatically discover the "white pages" directory number of the calling telephone. In the message to the Customer Service Center, however, there is a calling number: it is the designation of the dial-in port at the message switch, which the data processing center must use in the response message. As a further safeguard, an "activity number" is also in the heading, sequencing the uses of the specific port. A response message also must contain the "activity number" and it must match the current number, or else the response will be rejected instead of delivered.

The text is user-specified, but with control characters avoided. The

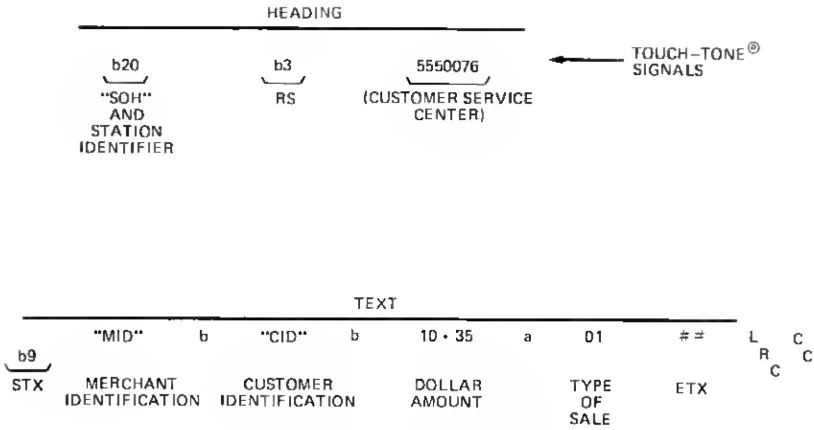

Fig. 7—Dial-in telephone message format.

example is for a credit card authorization as done with the Bell System Transaction I telephone.

Use of # # as ETX (End of Text) is a requirement, as are the LRC character (calculated using a four-bit representation of a *TOUCH-TONE* signal) and the character count (modulo 10) character. With these latter two characters, the 1 in 10^7 messages with undetected errors goal can be achieved on this link also.

Figure 8 shows some possible message transfers for this link. At the top is a simple inquiry and response. First is the answer tone from the message switch, then the message is sent. Not shown is the forwarding of it to the data processing center after the error, class-of-service, and other checks. The Customer Service Center, seeing from the Station Identifier field that an audio response is required, composes the response message in the following special way. In the station identifier field of the response message, it puts the code which instructs the message switch that the Audio Response Unit is to be used. In the text, the center uses triads of characters (maximum 128/3 = 42 triads). Each triad indicates a phrase chosen from the specified phrases for the Audio Response Unit. One phrase might be the utterance "ONE," another, "CHECKING TO SAVINGS TRANSFER." The phrases are then uttered in the sequence given.

In the simple transaction shown at the top of the figure, the attendant then hangs up. The telephone should send a "disconnect" sequence to the message switch, causing it also to hang up promptly and minimizing the connect time on the port, which is seized for the duration of the entire transaction. If the disconnect signal is not sent, up to 15 seconds additional connect time may occur before the message switch times out and hangs up.

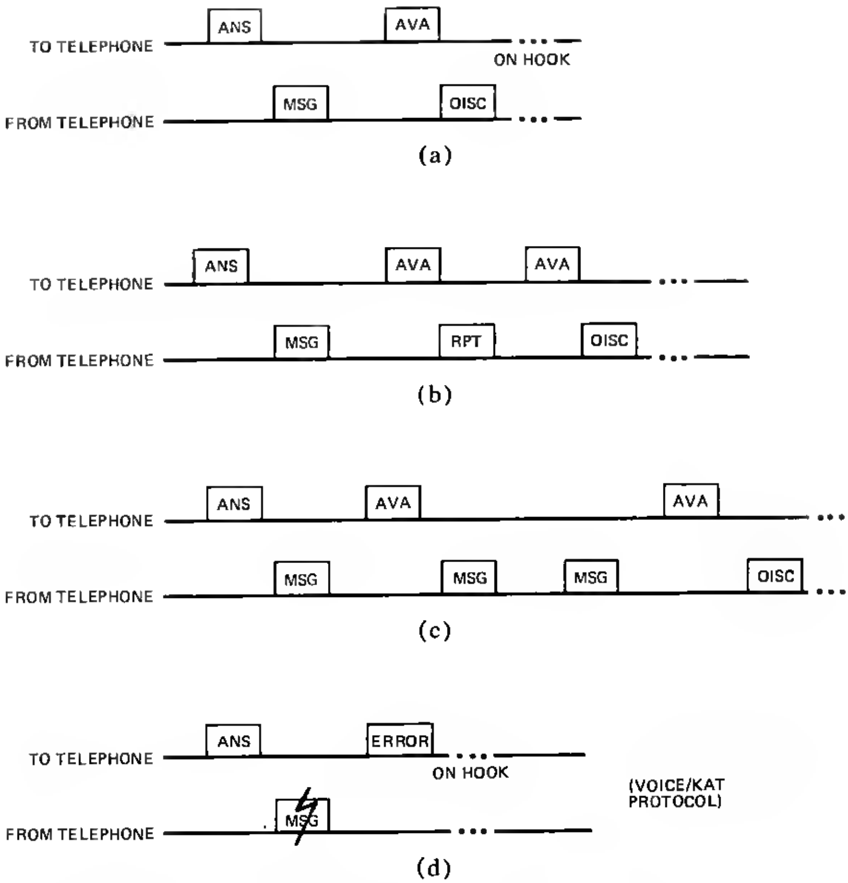

Fig. 8—Dial-in message transfer. (a) Normal dial-in transmission. (b) With AVA repeat. (c) Multiple messages. (d) Garbled transmission.

The second transaction in the figure shows the capability to request a single repeat of the audio message.

The third transaction shows the multiple inquiry capability of the Transaction Network. After the first inquiry, no heading may be input; the message switch will use the first heading for every message originated during the dial connection. Thus, all messages go to the same data processing center.

The last transaction illustrates that the Voice/KAT protocol has error detection capability, but no error correction through retransmission—a capability left to the more sophisticated "data-response" dial-in protocol and telephone. Having detected an error under the Voice/KAT protocol, the message switch announces a phrase such as "TERMINAL OR NETWORK TROUBLE. PLEASE HANG UP AND TRY AGAIN. GOODBYE" and disconnects.

VI. RELIABILITY AND MAINTAINABILITY

Reliability of service is achieved in the Transaction Network by using equipment redundancy, reliable components, fast and accurate diagnostic methods, and by prompt replacement of failed components.

The system consists of a dualized message switch which supports polled terminals on dualized dedicated transmission links by way of small dualized line concentration units (Data Station Selectors). Multiple dial-in ports are provided in central office line hunting groups for terminals which access the message switch by way of the dial network. Every part of the communication network, with the exception of the final serving loop, is protected from single failures.

The message switch is based on an enhanced version of a processor originally developed for a telephone Electronic Switching System. It operates on a working and hot spare basis and has a service reliability goal of 2 hours or less downtime in 40 years. The Data Station Selector is doubly fed by independent ports at the message switch and is itself redundant. If either of the backbone feeds or either of the two control portions of the Data Station Selector fails, then all the terminals are polled by the working sides. The message switch can command a status message from the Data Station Selector on its status and on the status of the loops to the terminals. Further, the message switch keeps track of the quality of transmission—the errors detected by parity and LRC checks—and issues trouble reports as appropriate.

Numerous loopback capabilities exist throughout the network for testing and trouble location: they are invoked periodically, or when trouble is detected, or under control of maintenance personnel.

Two "loopbacks" are of particular interest. To confirm proper installation of a polled terminal, it can send a message to itself through the message switch, thus testing the whole connection. The other is the same sort of capability for a Customer Service Center: this also is useful for testing before the Center begins service to terminals.

In the synchronous links, the message switch includes spare data sets, or, if the Digital Data System is used, spare Data Service Units, sparing being on a $1{:}n$ basis (where n represents the units in service). The spares can be inserted automatically. Customer Service Centers, of course, may wish to use more than one synchronous channel for reasons of reliability (additional to that made possible through alternate delivery) as well as for message traffic capacity.

Reliability of dial-in Automatic Voice Answerback service is achieved by having two on-line Audio Response Units, each connected to half of the hunting group terminations. If one fails, then all calls are taken by the other. The separate hunting groups for the ARU and for the Data Response telephones are sources of reliability, since any unit in a group is equally useful in answering calls.

Again, loopbacks within the equipment isolate the source of trouble

or simply verify continued correct service. The unit is busied out, of course, before such tests occur. As before, such tests are run routinely, when trouble occurs, or when maintenance personnel command them.

While routine diagnostics are functional in detecting and isolating equipment failures, and redundancy or recovery tactics are effective in maintaining service availability, the network ultimately requires repair. The Transaction Network makes use of the wide range of telephone plant facilities. In doing so, it crosses many lines of organization and of craftsperson jurisdiction. For these reasons, the system maintenance planning has been directed toward use of existing organization capabilities. For example, troubles detected in the message switching office are directed to the Switching Control Center by teletypewriter; line terminal problems are referred to Station Installation and Repair, etc. The objective always is to insure rapid dispatch of the appropriate repair forces and to localize the problem so the dispatch is most effective.

VII. ENVIRONMENT AND DESIGN

The Transaction Network Service message switching office utilizes the same electronic switching system technology for all input-output peripherals as the processor itself. Manufacturing techniques are therefore common throughout. Groups of communication line adapters are arranged in equipment units for ease of engineering, ordering, and installing additional capacity without service interruptions. Combined with these units are data sets of standard designs used for customer services across the range of current Bell System data communication service offerings. Hence, the data craftsperson works with familiar equipment. Any telephone central office presently supporting or designed to support ESS telephone switching machines (over 1000 such offices are in operation at this time) is an ideal location for a TNS switch.

Data Station Selectors, normally being installed in the same central office that provides telephone service to the customer, or on the customer's premises, are subjected to a much wider range of environmental conditions. The design makes use of those technologies providing the highest degress of reliability under adverse power and noise conditions. As small, complete units, tbey are conveniently ordered and installed in telephone or private branch exchange office space or even customer-premises wiring closets. The modular design permits equipping of only the number of lines needed at the particular location.

VIII. CONCLUSIONS

Hallmarks of the Transaction Network are reliability, speed of message transfer, error control, and economy, factors especially vital to

banking and financial communications and to many other areas of the short data message inquiry-response market. Reliability of service is achieved by extensive redundancy in equipment, the purposeful design of maintenance capabilities into the system, and the skill of Bell System personnel in establishing and maintaining the system. Speed of message transfer, with a high degree of error control, is achieved by careful system design, use of modern technology, and careful programming of software systems. Economy is based in part on modern technology and innovative system design and also on the shared use by customers of much of the system. The Transaction Network as outlined in this paper provides a new total communications system alternative to banking, the financial industry, and other industries requiring similar capabilities.

IX. ACKNOWLEDGMENTS

Numerous organizations and individuals participated in the realization of the Transaction Network system. Special recognition is due to L. R. Pamm, C. R. Moster, E. A. Irland, W. Ulrich, W. B. Cagle, T. M. Burford, and E. R. Kretzmer as directors of the organizations at Bell Laboratories in which the planning and development of the many hardware and software elements of the system were pursued.

APPENDIX

Listing of Acronyms Associated with Transaction Network and Transaction Network Service

ALA Asynchronous Line Adapter—interface to the message switch for 1200 b/s asynchronous communication.

ARU Audio Response Unit—output peripheral of the message switch for transmitting voice responses to telephone terminals.

ASCII American Standard Code for Information Interchange.

CLCI Common Language Circuit Identification—Bell System designation for a specific combination of circuit characteristics.

CSC Customer Service Center—a customer-owned data processing center which administers and maintains a data base information system.

CSU Channel Service Unit—a hardware device which terminates a channel on the customer's premises and provides the necessary maintenance, transmission power level adjustment, and protection features.

DBS Duplex Bus Selector—a hardware device giving either of duplexed message switches access to an I/O channel.

DLA Dial Line Adapter—interface to the message switch for dial network terminals.

DSS Data Station Selector—a line concentration device providing connection of up to 61 terminals to a common transmission facility on a polling basis.

FSK Frequency-Shift-Keyed—the type of frequency modulation used on 1200 b/s transmission channels.

KAT Keyed Answer Tone—pulse length modulation of a single frequency tone.

LAS Line Adapter Selector—an addressable concentrator for asynchronous or dial line adapters.

LHC Line Hunting Group—a group of telephone lines from which an idle line will be selected when a single telephone number is dialed.

MPCH Main Parallel Channel—a primary high speed I/O channel of the message switch.

MS Message Switch—the central control which routes messages, administers and performs maintenance diagnostics on the communication network, and performs billing functions.

PAC Polled Access Circuit—the asynchronous polled interface to the message switch, comprising duplexed line adapters, transmission facilities, and data station selectors.

PROMATS Programmable Magnetic Tape System—A magnetic tape system interfaced to the message switch for recording billing data.

SCAM Switch Control and Monitor—equipment which monitors the message switch I/O hardware, network status, power, and alarms and under message switch control performs equipment and channel protection switching.

SPCH Sub-parallel channel—An addressable I/O channel which connects peripheral devices to the main I/O channel of the message switch.

SLA Synchronous Line Adapter—Interface to the message switch for 2.4, 4.8, or 9.6 kb/s channels to Customer Service Centers.

TID Terminal Identity Code—a unique number assigned to each terminal served by TN.

TN Transaction Network–the entirety of message switch, I/O peripherals, communication channels, data station selectors, and local loops used in providing Transaction Network Service.

TNE Transaction Network Exchange—The area served by a Transaction Network message switch and described by a unique three-digit number in the seven-digit numbering plan.

TNS Transaction Network Service—the total end-to-end service and feature set provided by connection to TN.

TNCSB Transaction Network Customer Service Bureau—the Transaction Network administrative entity responsible for handling the

addition, removal, changes, and problems related to individual customer services.

TRANSPLAN Transaction Network Service Planning model—a time-shared computer program package available to operating telephone companies in planning the introduction of TNS.

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